Status of Data Sources on Fish Consumption in the United States

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Introduction

Quantitative information about fish[1] consumption is important from several standpoints. Fish represent a major food source with a growing potential for significant market development as some of the unique nutritional properties of fishery products are revealed through contemporary research. Consumption data bases that are well defined, validated, and accessible would be particularly useful to nutritionists and others in the medical community concerned with the relationships between diet and human health. Marketing specialists, fishery resource managers, and administrators concerned with maintaining an ecological balance in the aquatic environment would also benefit from such information.

As a natural living resource, however, fish are continually exposed to many environmental pollutants and thus are susceptible to contamination by substances which, if admitted to the human diet, may be hazardous to the health of the consumer. Fish constitute the only class of foods subject to total governmental prohibition in large geographic areas of the U.S. for substantial time periods.

The contaminants that have assumed such serious proportions at various times are of several types and sources. They include infectious agents derived from human waste, such as the hepatitis virus and other enteric viruses, natural toxicants such as paralytic shellfish toxins, industrial chemicals such as polychlorinated biphenyls, and some contaminants originating from both industrial and natural sources, such as mercury. The Food and Drug Administration (FDA), National Marine Fisheries Service (NMFS), Environmental Protection Agency (EPA), and other organizations routinely sample fish according to their various mandates to determine levels of many of the more commonly occurring or more hazardous contaminants.

Because both the beneficial and harmful properties of a fish-based diet may differ with species of fish, consumption frequency, and physical condition of the consumer, it is important in public health assessment to estimate the quantity and kind of fish consumed and the demographic distribution of consumption by subgroups of the population. Important factors governing the degree of biologic effect, positive or negative, by a food component are the quantity of that component taken into the body and its chemical form and reactivity.

Despite the importance of information on fish consumption to decisions in public health, law, and business, much of that information is poorly documented. The purpose of this report is to document the existence and characteristics of available data sources and to evaluate the strengths and limitations of each data source. It is neither within the scope of this paper to analyze each data file for distribution of fish intake by fish species or by human population subgroups nor to determine the identity and concentration of potentially beneficial or harmful substances in fish. Such analyses will need to be done later to perform assessments of consumer exposure to fish constituents in the diet. These in turn may be used to guide decision making in health and regulatory agencies regarding the quality and safety of foods derived from fish.

Consumption of fish by the U.S. population has been estimated from three general types of information: 1) Commercial production data on landings, imports, and exports of food fish; 2) national surveys of food intake, including fish, and 3) several national surveys that have been conducted which are specific for fish intake. Per capita consumption can be estimated either by dividing total fish production intended for domestic use by the number of people in the U.S. population or by selectively sampling the fish intake of individuals in the population and extrapolating the results to the entire U.S. population. Many samples of food intake by individuals are available for local areas and restricted population groups but there are a limited number of national samples. The U.S. Department of Agriculture (USDA), starting in 1909, has annually published the average consumption of several types of food such as meat, fish, and vegetables by dividing the total quantity of each food marketed in the U.S. by the population (Friend et al., 1979). These data are useful for general evaluations and study of trends but are of little help in estimating the variation in the amounts of each food eaten by individuals and of even less use in estimating food intake by subsets of the population.

Fish species (organs included), processing steps, and food preparation pro-

[1]The term fish is used throughout this paper to describe both finfish and shellfish of marine or freshwater origin. The fish may be fresh, frozen, canned, or processed in other ways. They may be consumed as a single dish or combined with other foods in mixed dishes.

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cedures are described in varying levels of detail within each data source and among data sources. For example, in the USDA 1965 survey of food intake of individuals (USDA, 1972) there were food codes for 89 dishes composed mainly of fish. Some fish such as halibut were coded separately while other types of fish such as crabs were grouped. There is little or no cross referencing of either the food codes or food names among the various data sources. Therefore, comparisons of estimates of fish intake must be done by manual, ad hoc methods based on varying sets of classification assumptions.

Fish Production Data

Production data are available from NMFS for commercially harvested marine and freshwater fish. Commercial seafood production is closely monitored and reported weekly. These reports are summarized annually in "Fisheries of the United States" (NMFS, 1985). The data are tabulated on balance sheets from which per capita civilian consumption is calculated by accounting for exports, imports, inventory changes, and military purchases. Such a calculated average consumption is on an edible weight basis but is usually greater than the actual human consumption because of seafood lost through spoilage or diverted into pet food or livestock feed. The balance sheet also does not list commercial freshwater fish, recreationally caught fish, or marine fish sold at roadside stands.

Data on recreational catches (NMFS, 1984) are based on rather indirect measures such as intercept survey interviews of fisherman and are generally less useful for estimating production. The USDA calculates annual per capita fish intake by adding an estimate of recreationally caught fish and the other types of data to the commercial seafood production just described to calculate the total fish consumption.

General Food Intake

USDA 1965-66

The first national food intake survey for which detailed information is available for individuals was conducted in 1965-66 (USDA, 1972). A survey was taken of the food intake of 14,519 individuals in April, May, and June, 1965. After household data were gathered, the respondent, usually the homemaker, was asked for information on all foods eaten by each household member in the previous 24-h period. The survey was designed to sample all days of the week equally. Considerable demographic and socioeconomic data were recorded but geographic area was only coded down to the level of the nine national census divisions, each comprised of several states. A magnetic tape copy of survey results was provided to the FDA in April 1971. The individual survey results have been used extensively in estimating exposure to food additives and contaminants. This survey has also been used by the EPA for exposure assessment and risk assessment. [A copy of the survey data can be obtained on magnetic tape from the National Technical Information Service (NTIS), Springfield, VA 22161 (PB 80-195145/HAE Nationwide Food Consumption/Individual - Spring Qtr 1965).]

Documentation of the survey design and procedures is available but, as often happens with large data bases, there are some discrepancies among different editions of the file. For example, although the original results were reported for 14,519 surveyed people, the file supplied to the FDA contained records for only 14,352 people. Only dishes composed mainly of fish or shellfish were included in the published report in the fish and shellfish category (USDA, 1972). Mixed dishes such as fish pot pie were tabulated with other mixed meat dishes containing other types of meat, including beef and pork, in a category called mixtures. The detailed data are still available and the total intake of fish could be calculated for each individual in the survey if recipes were available from which to estimate the proportion of fish in each mixed dish. However, there is no national file of standard recipes. Such a file could be created but it would be difficult to do because of the large size of the project and the relative unavailability of recipes for proprietary food products. Fish intake during the spring months of this survey is probably not the same as for other seasons such as the recreational fishing season in the summer. For this reason, data from this survey are not suitable for determining seasonal patterns of fish consumption.

USDA 1977-78

A national survey of food intake, called the Nationwide Food Consumption Survey, performed by the USDA in 1977-78 was expanded from the one in 1965-66 (Pao et al., 1982). The individual intake portion of the survey, comprising 30,770 people, was carried out in all seasons of the year, and contained food intake data over a 3-day period for each person. One person, usually the homemaker, was asked to recall the identity and amount of each food item eaten at each meal or snack by every household member during the prior 24 hours and to keep a diary of such information for the next 2 days. Respondents were also asked if the day's intake was typical and if they were on a special diet, were vegetarians, or took vitamins, minerals, or other supplements. Extensive demographic and socioeconomic data were recorded for each sampled person but the geographic area of residence was coded only to a multistate census division level. [Copies of the data tapes involved may also be obtained from NTIS (PB 80-190218/HAE Nationwide Food Consumption Survey/Individual-Spring Qtr 1977-78, PB 80-197429/HAE Nationwide Food Consumption Survey/Individual-Summer Qtr 1977-78, PB 80-200223/HAE Nationwide Food Consumption Survey/Individual-Fall Qtr 1977-78, and PB 81-118853/HAE Nationwide Food Consumption Survey/Individual-Winter Qtr 1977-78).]

NHANES I

The first National Health and Nutrition Examination Survey (NHANES I) of about 32,000 people aged 1-74 years in the U.S. was conducted by the National Center for Health Statistics in 1971-75. Food intake was obtained for a subset of 20,749 people aged 1-74 through a 24-h dietary intake recall interview and a food frequency interview. However, food eaten on weekends

was seldom recorded. Health status was determined through interviews, physical examinations, and other diagnostic procedures. In addition, a subset of people aged 25-74 was examined in greater detail for arthritic, respiratory, cardiovascular, and other conditions. NHANES is the only type of national survey in which food intake and state of health were determined in the same people. The sampling design was complex; the sampling was stratified and therefore was not uniform over all parts of the country and all subgroups of the population. There were limited geographic sampling sites and oversampling of some groups such as persons with low income, preschool children, women of child-bearing age, and the elderly. For logistical reasons, sampling was done in the north in the summer and in the south in the winter. [A copy of the data tape on food consumption is available from NTIS (PB-297339/HAE HANESI - 24 Hour Food Consumption Survey No. 4704). Dietary frequencies and medical examination results are on other tapes available from NTIS.]

NHANES II

Data similar to NHANES I were collected in NHANES II in 1976-80 through response to questionnaires on medical history, food consumption, and health-related behavior. Data also were collected through direct medical examination. NHANES II was conducted on a nationwide probability sample of 20,322 persons ages 6 months to 74 years from the civilian noninstitutionalized population of the United States. Food consumption data are in the form of quantities of food consumed and frequency of eating in a 24-h recall period. [A copy of this tape can be obtained from NTIS (PB 82-142639/HAE HANESII - 24 Hour Recall - Spec Food/Cat 5704). Dietary frequencies and medical examination results are on other tapes available from NTIS.]

Proprietary Surveys

Some proprietary surveys of food intake are available. One of the largest of these is a sample of food frequency conducted periodically by the Market Research Corporation of America (MRCA)[2]. The food products purchased by each of the 4,000 sampled households of each survey, which is inappropriately called a menu census, are described in detail by MRCA and the frequency of the consumption of each food is recorded in daily diaries over a 2-week period. The quantity of each food eaten by each person is not recorded; however, brands and food packaging materials are described. The sample is balanced as closely as possible within each quarter to the U.S. census by various demographic socioeconomic variables. Because the data are owned by a private company, access to the information is limited and is available only on a fee-for-service basis. The 1976 special search on fish consumption conducted on Menu Census 4 data by MRCA for the FDA does not provide the specifics needed to estimate consumption of fish by species. [Further information can be obtained from MRCA, 2215 Sanders Rd, Northbrook, IL 60062.]

Fish Intake

A closer look at fish intake data sources will convey some idea as to the exact coverage of the data and the degree of confidence which can be placed in them.

Market Facts 1969-70

A national survey of fish purchases was conducted in 1969-70 by Market Facts, Inc., under contract to the NMFS. It comprised a 1-year fish purchase diary survey of 1,586 households (4,864 individuals) in the United States. Each household completed a diary twice monthly of fish purchased by species. Purchases were recorded for households, not for individuals. Only fragmentary documentation for the methods and survey results is available. The original database is now irretrievable despite attempts at reconstruction. It cannot be determined exactly how the quantity of fish in mixed dishes was calculated. There are also conflicting reports on the inclusion or exclusion of gamefish in the database. Despite these uncertainties the average fish intake was in general agreement with the NMFS annual balance sheets. The final report is available from the Office of Utilization Research, NMFS, NOAA, Washington, DC 20235.

[2]Mention of trade names or commercial firms or products does not imply endorsement by the National Marine Fisheries Service, NOAA.

NPD 1973-74

A national fish intake survey of 7,662 households comprising 25,165 people was conducted in 1973-74 by NPD Research, Inc., with funding from the Tuna Research Foundation (TRF). Participants kept a diary for 30 days of all intake of fish and recorded the total intake of each species of fish by family members for each day. A magnetic tape copy of the survey results was obtained by the NMFS. An adhoc committee of FDA, USDA, NMFS, and TRF representatives reviewed the data, revised them as seemed necessary, and apportioned intake among family members of different age and sex groups by use of average portion size data from the 1965 USDA survey if portion sizes had not been reported by the panel member. A subfile of the 24,652 persons who reported eating fish during the 30-day period was provided to the FDA. Although the survey seems to have been well conducted, documentation of methods and results is not complete. In addition, records are lacking for those who ate no fish. There is insufficient information to determine how the proportion of fish in mixed dishes was calculated. [A copy of this tape can be obtained from NTIS (PB 294725/HAE Fish Consumption Data 1973-1974).]

MRCA 1980-81

MRCA, under NMFS contract, performed a national survey of fish intake in 1980-81. The survey was designed to collect from its total National Consumer Panel (NCP) of 7,500 households, representative of all U.S. households, augmented to include Alaska and Hawaii, written records of each of their purchases of fish, shellfish, or products made from them, on a continuing basis through the NCP weekly diary for a 52-week period. Each household provided complete details on every such item brought into the home, either purchased, caught recreationally, or received as a gift. The information was

recorded in appropriately designed diary sections, and returned to MRCA at the end of the week. As far as possible, the same households continued to report for the full 12-month period. Dropped households were replaced to maintain a demographically balanced sample of 7,500 reporting households.

At the same time, each of these households also recorded in a special monthly diary, for one month per quarter, each occasion of serving and eating fish or fish products, or dishes made from them. All fish meals were included, whether prepared and eaten at home, obtained and eaten away from home, carried and eaten away from home, or caught and recreationally eaten "in the field" by any member of the household. Each eater was identified, including guests, by age and sex. Different thirds of NCP were covered each month of every quarter through the year. An extensive set of demographic characteristics was collected from each household, and from each individual in the household.

Part of the survey results pertaining to purchases and attitudes have been released but the data for fish intake per se have not. Inquiries about availability of these data should be addressed to the Chief, National Fisheries Statistics Program, NMFS, NOAA, Washington, DC 20235.

Analyses

Despite deficiencies in obtaining and documenting data on fish intake, different estimates of per capita intake of fish are fairly close. One of the more recent and extensive reviews of fish intake data sources was done by SRI International for the EPA to aid EPA in evaluating the hazard of water contaminants (Javitz[3]).

Wagstaff (1983) found that, during the decade from 1965 through 1974, the range over the nine data sources evaluated was about 10-20 g/day. Part of the difference is probably due to an overall increase in fish intake over the 10-year period. The NMFS has contracted with Pennsylvania State University to consolidate and analyze fish intake data from four of the data sources described in this report. Results of that contract have not been released because the results of the MRCA 1980-81 survey have not become available.

Fish Recipes

It is difficult to determine the type and species of fish eaten or the quantity of fish eaten when the fish is part of a mixture of fish and other ingredients. At present, there is no set of standard recipes of fish dishes which is used to determine the proportion of each dish that is fish. Because of this lack, fish intake estimates have to be based on assumptions regarding proportion of fish in mixed dishes. Efforts are being made to locate recipes of dishes containing fish and to construct a table of proportions of fish by species in mixed dishes.

Discussion and Conclusions

Coverages of the various fish intake data sources overlap to a large degree but are not identical. There are inconsistencies, missing data, lost documentation, and implausible survey results. Thus it was surprising that the per capita consumptions of fish estimated from various of the data sources are relatively close (Wagstaff, 1983). Although survey design could be improved, the major area needing improvement is quality control in conducting a survey, including preserving and processing the data, documenting the whole survey process, and issuing final reports. The funding organizations do not expend sufficient effort in monitoring the contractors' work and in analyzing data and interpreting them to address societal needs. The cause of exposure assessment would be better served by conducting fewer surveys with high quality followup on each survey. It is our view that, for the present, efforts should be diverted from planning new surveys to adequate analysis of data from past surveys.

There are several other factors which should be considered in evaluating food exposure data. Some of these have been discussed by Wagstaff (1982). The calculation of per capita food consumption from production totals can apply only to a single national average. Surveys of individual food intakes provide estimates of distributions of food intake within the population for age, race, sex, and socioeconomic groups. But geographic distribution is available only at the regional or state levels. The number of people sampled is generally too small to derive any reliable estimates at the county level, and it is unlikely that a large enough survey of food intake will ever be taken to obtain county level data for the entire country.

The moderate differences in the various sources of data on food intake should give pause to blind acceptance of food intake data. Sometimes food intakes are calculated to several digits past the decimal. Such detailed presentation is misleading. On the other hand, the general agreement of estimates from different data sources engenders confidence that the estimates are close to reality. Decisions should not be postponed indefinitely while waiting for ultimate proof. Instead, exposure assessments should be done and decisions made as they are needed based on the best information available at the time and then revised if necessary when better information becomes available.

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